High vowel nasalization and contrast preservation in French

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Main points:

- French appears to present a case of anti-neutralization where regressive nasalization applies only to vowels which do not have contrastive counterparts (i.e., high vowels).
- As partial height neutralization must create the gap for nasalization to apply, this case of anti-neutralization is more difficult to formalize.
- In this presentation, I offer a product-oriented analysis which captures the central role of contrast and does not depend on underspecification, using Preservation of Contrast theory (Łubowicz 2002, 2012).

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1. Introduction

(1) Obstacles to anti-neutralization in Optimality Theory (OT):

- Contrast, though still a distributional property, not built into grammar as a pre-derivational restriction (cf. Richness of the Base).
- Rule/process undergoers not specified — determined rather by goodness of output structure and correspondence with input structure
- Without source-oriented generalizations, contrast-based blocking requires ability to "look backwards."

(2) The **French Paradox** (cf. §2): input high nasal vowels lowered (/i^{n}/ → [ĩ]), while only high vowels undergo regressive nasalization (/in/ → [ĩn], /ɛn/ → [ɛn], *[ɛ̃n], etc.).

(3) Previous accounts:

   a. **Source-oriented:** high vowels specified as sole undergoers (esp. rule-based analyses); no paradox, but lacks explanatory adequacy.
   b. **Representational:** high oral vowels are underspecified and thus can undergo nasalization (e.g., Spears 2006); captures role of contrast but risks circularity and does not address deeper concerns (esp. markedness relations).

(4) Analyzed here as *anti-neutralization*: nasalization applies only insofar as it creates allophonic outputs ≈ blocked where neutralized outputs would be created.

(5) Since the gap for nasalization must be created by lowering, single-constraint anti-neutralization approaches *MERGE (Padgett 2003) and NONEUTRALIZATION (Kiparsky 2008) prove too strong.

(6) An analysis in Preservation of Contrast allows for balance via multiple incomplete transformations, within a product-oriented framework driven by universal markedness.

2. Background

2.1. Data

(7) [$\tilde{V}$] ~ [VN] alternations in French (e.g., masculine ~ feminine):

	Faithful		*Unfaithful*
a.	[peizɑ̃] ~ [peizan]		
b.	[sɛʁtɛ̃] ~ [sɛʁtɛn]	e.	[fɛ̃] ~ [fin]
c.	[bɔ̃] ~ [bɔn]		
d.	[ʒœ̃] ~ [deʒøne]	f.	[bʁœ̃] ~ [bʁyn]

(8) Traditional analysis:

- Underlying vowel quality inferred from [VN] (e.g., Schane 1968).
- Where alternations occur, [$\tilde{V}$] ← vowel + floating [nasal], /V^n/ (e.g., Tranel 1992).
- High nasal vowel lowering: /i^n, y^n/ → [ɛ̃(, œ̃)] — when motivated phonologically, by markedness (cf. José & Auger 2004 for Picard).

(9) In instrumental studies on regressive nasalization in French, rates often highest on high vowels (cf. below; counterexamples: Clumeck 1976, Montagu 2007).

	Study	*Method*	/i/	/ɛ/	/a/
a.	Delvaux et al. 2008	Aerodynamic	22%	7%	
b.	Dow 2014	Nasometric	66–84%	27–40%	23–24%
c.	Rochet & Rochet 1991	Nasometric	60%	25%	20%
d.	Spears 2006	Acoustic	57%	10%	—
e.	Montagu 2007	Nasometric?	35%	35%	45%

2.2. Possible explanations

(10) **The paradox:** one part of the grammar penalizes only high nasal vowels, while another seemingly prefers them alone (assume simple threshold: nasality > 50% = [+nasal]).

(11) Competing explanations offer contradictory conclusions regarding markedness relations among $\tilde{V}$, linked to concerns about the scope of nasalization.

(12) Inventory production: non-high $\tilde{V}$ less marked than high $\tilde{V}$?

- Processes repairing illicit structure lead to a reduction in markedness.
- /i^n/ → [$\tilde{\varepsilon}$] implies the former is more marked.
- **Supporting evidence:** mid & low vowels inherently longer than high, and nasality preferred on long vowels (cf. Hajek 1997).

(13) Regressive nasalization: high $\tilde{V}$ less marked than non-high $\tilde{V}$?

- Processes generally do not favor marked forms *to the exclusion* of less marked.
- If nasalization targets *only* high vowels, they should be least marked.
- **Supporting evidence:** in aerodynamic (Clark & Mackiewicz-Krassowska 1977) and articulatory (e.g., Bell-Berti 1993) terms, high vowels are the easiest to nasalize, as well as perceive as nasal (p. ex. Maeda 1982).

(14) If high $\tilde{V}$ < non-high $\tilde{V}$, lowering loses synchronic motivation. With reverse scale, nasalization seems to select only more marked forms (esp. source-oriented analysis).

2.3. Adopted analysis

(15) *Purely phonological approach*: no phonetically-sensitive constraints (e.g., ease of articulation, or height perception in [$\tilde{V}$N] vs. in [$\tilde{V}$(C)]).

(16) *Markedness scale*: independent evidence for non-high $\tilde{V}$ < high $\tilde{V}$:

- Ruhlen's (1975) survey of 100 inventories (allophonic and phonemic $\tilde{V}$): gapped and discontiguous inventories exist, but none lack a low nasal vowel (possible exception: Mohawk).

	Ebrie			Dakota			Breton (Groix)	
a.	x	x	b.	ĩ	ũ	c.	x	x
	ẽ	õ		x	x		x	x
	ã			ã			ã	

	Hare			Hottentot (Nama)	
d.	ĩ	ũ	e.	ĩ	ũ
	ẽ	x		x	õ
	ã			ã	

	Siriono			Tamil	
f.	ĩ ɨ̃	x	g.	x	ũ
	ẽ	õ		ẽ	õ
	ã			ã	

- If low vowels are least marked, typology can be predicted and overgeneration of unattested grammars (e.g., only high $\tilde{V}$) preventable, esp. in stringency.

(17) *Scope of nasalization*: selective blocking, vs. selective application. [VN] triggers as marked structure, but vowels with contrastive nasal counterparts resist nasalization, in order to avoid neutralization.

(18) Summary:

- Lowering of high $\tilde{V}$ occurs because of markedness pressures ([ĩ] > [ɛ̃]).
- Nasalization, driven by markedness of [VN], cannot apply to mid and low vowels because of the existence of their nasal counterparts in contrastive positions.
- Nasalization is not blocked from applying on high vowels because lowering prevents [ĩ] in contrastive positions.

3. Formalization

3.1. PC theory: Fundamental aspects

(19) Lightly adapted from Łubowicz (2002, 2012), radical overhaul of OT which captures opacity, neutralization, and anti-neutralization. (And allophony?)

(20) Contrast plays an active role in grammar, not a distributional epiphenomenon.

(21) Candidates:

- Mappings can reference each other. ("Nothing takes place in a vacuum.")
- Candidates in GEN made up of scenarios, each a finite and limited number of inputs with corresponding outputs.
- From one scenario to the other, only outputs vary (i.e., the inputs stay the same).

(22) Two evaluations: (1) against PC (PRESERVECONTRAST) and markedness constraints, (2) against faithfulness (if necessary).

(23) PC constraints: input-oriented (compares input pairs with outputs) and output-oriented (compares identical outputs with corresponding inputs).

3.2. French analysis

(24) Some *a priori* considerations:

- "Docking" occurs early: /V^n/ = nasal input, /V^n + FEM./ → /VN/ = oral input
- Locus of PC evaluation is *segment*, i.e., the vowel of [ɛ̃N] = [ɛ̃(C)], etc.
- Two archetypes of inputs represented (i.e., /i, e/) because of potential of interaction. Violations involving /a, o/ are subset of those of /e/ (no height neutralization in addition to no nasalization).

(25) Constraints:

Markedness

a. *VN : Sequences of oral V + nasal consonant are banned.

b. *ĩ : High nasal vowels are banned.

PC constraints

c. PC_{IN}(nasal) : For each pair of inputs contrasting in the feature [nasal] that map onto the same output in a scenario, assign a violation mark. ("If inputs are distinct in nasality, they must remain distinct in the output, though not necessarily in terms of the feature [nasal].")

d. PC_{OUT}(nasal) : For each output that corresponds to two or more inputs contrasting in the feature [nasal], assign a violation mark. ("No outputs ambiguous with respect to nasality.")

e. PC_{IN}(high) : For each pair of inputs contrasting in the feature [high] that map onto the same output in a scenario, assign a violation mark. ("If inputs are distinct in nasality, they must remain distinct in the output, though not necessarily in terms of the feature [high].")

f. PC_{OUT}(high) : For each output that corresponds to two or more inputs contrasting in the feature [high], assign a violation mark. ("No outputs ambiguous with respect to the feature [high].")

(26) Scenarios & tableau (see ((27)) for notes)

Inputs	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.
$i^n \rightarrow$	$\tilde{\imath}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\imath}$	$\tilde{\varepsilon}$	$\tilde{\imath}$	$\tilde{\imath}$	$\tilde{\imath}$
$e^n \rightarrow$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$	$\tilde{\varepsilon}$
iN $\rightarrow$	iN	iN	$\tilde{\imath}$N	$\tilde{\imath}$N	$\tilde{\varepsilon}$N	$\tilde{\varepsilon}$N	$\tilde{\imath}$N	iN	$\tilde{\imath}$N	iN	$\tilde{\varepsilon}$N
eN $\rightarrow$	εN	εN	εN	$\tilde{\varepsilon}$N	$\tilde{\varepsilon}$N	εN	$\tilde{\varepsilon}$N	$\tilde{\varepsilon}$N	εN	$\tilde{\varepsilon}$N	εN

Ranking: PC_{OUT}(nasal) $\gg$ *VN $\gg$ *$\tilde{\imath}$, PC_{IN}(nasal), PC_{IN}(high), PC_{OUT}(high)

	PC_{OUT}(nas)	*VN	*$\tilde{\imath}$	PC_{IN}(nas)	PC_{IN}(high)	PC_{OUT}(high)
a.		**!				
b.		**!			* {/e^n, i^n/}	* [$\tilde{\varepsilon}$]
c. ☞		*	*		* {/e^n, i^n/}	* [$\tilde{\varepsilon}$]
d.	*! [$\tilde{\varepsilon}$]		*	* {/e, e^n/}	* {/e^n, i^n/}	* [$\tilde{\varepsilon}$]
e.	*! [$\tilde{\varepsilon}$]			** {/e, e^n/} {/i, i^n/}	** {/e^n, i^n/} {/e, i/}	* [$\tilde{\varepsilon}$]
f.	*! [$\tilde{\varepsilon}$]	*		* {/i, i^n/}	** {/e^n, i^n/} {/e, i/}	* [$\tilde{\varepsilon}$]
g.	*!* [$\tilde{\varepsilon}$] [$\tilde{\imath}$]		**	** {/e, e^n/} {/i, i^n/}		
h.	*! [$\tilde{\varepsilon}$]	*		* {/e, e^n/}	* {/e^n, i^n/}	* [$\tilde{\varepsilon}$]
i.	*! [$\tilde{\imath}$]	*	**	* {/i, i^n/}		
j.	*! [$\tilde{\varepsilon}$]	*	*	* {/e, e^n/}		
k.	*! [$\tilde{\varepsilon}$]	*	*			

(27) Notes on tableau/scenarios:

- Text under PC constraint violations indicate offending output or pair(s) of inputs.
- Scenarios involving raising legitimate, but gratuitous: fare equally under PC constraints, but worse on markedness.
- Denasalization in /V^n/ inputs also legitimate but also gratuitous, especially when oral vowels in non-nasal contexts are considered.

(28) Due to strength & high ranking of PC_{OUT}(nasal):

- If /i^n/ → [ĩ], no nasalization in VN possible.
- If /i^n/ → [ɛ̃], nasalization possible in /iN/, though promotion of *ĩ and/or faithfulness in the second pass can prevent, if desired.
- As long as nasal inputs remain faithful, no merged/identical output tolerated if sources differ in nasality (unlike /i^n, e^n/).

4. Discussion & further work

(29) Oro-nasal contrast in high vowels transformed into one of height: partial height neutralization (consistent with markedness) creates small gap for nasalization to apply (seemingly inconsistent with markedness).

(30) French anti-neutralization simple to state informally but requires a formal framework with (a) contrastive "hindsight," and (b) flexible understanding of neutralization.

(31) Single constraint approaches to anti-neutralization fail to capture this balance:

- NoNeutralization in Stratal OT (Kiparsky 2008) demands different lexical strata (not the case in French).
- Both NoNeutralization and *Merge (Padgett 2003) penalize *any* neutralization, while in French both height and oro-nasal neutralization must occur *partially*.

(32) Representational approaches (e.g., "High oral vowels are not specified for [nasal] and thus can undergo nasalization") capture the system of contrast but fail to capture the link between lowering and nasalization.

(33) Future work (data collected on same participants as Dow (2014)):

- Is high vowel nasalization phonological? Articulatory and durational evidence say maybe not. → Variable-rate reading task (à la Solé (1992)) carried out. (Does duration of nasalized portion increase proportionately to V duration?)
- How does progressive nasalization play into phonological grammar? Phonetically more pervasive in French, but regressive nasalization more likely to be phonological. → Data from normal and variable-rate reading task collected.

(34) **Summary:** Regressive nasalization in French suggests that not only must contrast be able to play a role in mappings, but also that one (partial) neutralization must be able to pave the way for another process to apply, whether itself neutralizing or allophonic, which PC theory (alone?) can formalize.

References

Bell Berti, F. (1993). Understanding velic motor control: Studies of segmental context. In Huffman, M. K. and Krakow, R. A., editors, *Phonetics and Phonology, vol. 5: Nasals, Nasalization and the Velum*, pages 63–85. Academic Press, New York.

Clark, W. M. and Mackiewicz Krassowska, H. (1977). Variation in the oral and nasal pressure levels of vowels in changing phonetic contexts. *Journal of Phonetics*, 5:195–203.

Clumeck, H. (1976). Patterns of soft palate movements in six languages. *Journal of Phonetics*, 4(4):337–351.

Delvaux, V., Demolin, D., J-Tarmegnies, B., and Soquet, A. (2008). The aerodynamics of nasalization in French. *Journal of Phonetics*, 36(4):578–606.

Dow, M. (2014). *Contrast and markedness among nasal(ized) vowels: A phonetic-phonological study of French and Vimeu Picard*. PhD thesis, Indiana University.

Hajek, J. (1997). *Universals of sound change in nasalization*. Blackwell, Oxford.

José, B. and Auger, J. (2004). (Final) nasalization as an alternative to (final) devoicing: The case of Vimeu Picard. *IULC Working Papers Online*, 4(3):1–44.

Kiparsky, P. (2008). Fenno-Swedish quantity: Contrast in Stratal OT. In Andrew Nevins and Bert Vaux, editors, *Rules, constraints, and phonological phenomena*.

Łubowicz, A. (2002). *Contrast preservation in phonological mappings*. PhD thesis, University of Massachusetts Amherst.

Łubowicz, A. (2012). *The Phonology of Contrast*. Equinox, Oakville, CT.

Maeda, S. (1982). Acoustic cues for vowel nasalization: A simulation study. *Journal of the Acoustical Society of America*, 72, Suppl. 1:S102.

Montagu, J. (2007). *Etude acoustique et perceptive des voyelles nasales et nasalisées du français parisien*. PhD thesis, Université Paris 3.

Padgett, J. (2003). Contrast and post-velar fronting in Russian. *NLLT*, (21):39–87.

Rochet, A. P. and Rochet, B. L. (1991). The effect of vowel height on patterns of assimilation nasality in French and English. In *Proceedings of the 12th International Congress of Phonetic Sciences, vol. 3*, pages 54–57, Aix-en-Provence.

Ruhlen, M. (1975). Patterning of nasal vowels. In Ferguson, C., Hyman, L., and Ohala, J. J., editors, *Nasálfest: Papers from a Symposium on Nasals and Nasalization*, pages 333–351. Stanford University, Department of Linguistics.

Schane, S. (1968). *French Phonology and Morphology*. The MIT Press, Cambridge.

Solé, M. J. (1992). Phonetic and phonological processes: The case of nasalization. *Language and Speech*, 35(1):29–43.

Spears, A. (2006). Nasal coarticulation in the French vowel /i/: A phonetic and phonological study. Master's thesis, University of North Carolina at Chapel Hill.

Tranel, B. (1992). On suppletion and French liaison. In *Romance languages and modern linguistic theory: Papers from the 20th Linguistic symposium on Romance languages (LRSL XX)*, pages 269–308.